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A Taxonomic Study on the Ophiuroidea from the Yellow Sea*

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黃海産 거미불가사리類에 관한 分類學的 硏究*

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摘　　要

海洋硏究所에서 1982年 부터 1984年에 걸쳐 수행한 韓國海域綜合海洋環境圖作成 硏究 사업과 기타 海洋調査中 채집된 黃海産 거미불가사리를 調査한 결과, 7科 12屬 25種이 同定되었으며 이 중 *Amphiura iridoides*, *A. syntharacha*, *Amphioplus astericus*, *Opionereis sasakii* 및 *Stegophiura viripara*의 5種이 韓國未記錄種으로 밝혀졌다.

Key words: Taxonomy, Ophiuroidea, Yellow sea.

INTRODUCTION

Little is known on the fauna of ophiurans in the Korean waters, as only a few authors have paid attentions so far on the subject. Since Duncan (1879) have reported sixteen species of ophiurans including thirteen new species from the Korea Strait, only seventy five species of ophiurans were collected during the last century. H.L. Clark (1911) reported nineteen species from the Korea Strait and East Sea, and Matsumoto (1917) reported one species from the southern coast. Recently, twenty eight species were added to the list of ophiurans in the Korean waters by several authors (Rho & Kim, 1966; Lee, 1971; Rho, 1979; Yi, 1983; Shin, 1984; Shin & Rho, 1986).

As a result of examination, twenty five species including five new record species of ophiurans in

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the Korean waters were identified.

The key provided in this study was tentatively arranged for the ophiurans collected in the eastern part of the Yellow Sea and further rearrangement should be taken as the knowledge on ophiurans grows.

MATERIALS AND METHODS

Materials used in this study were exclusively collected by S-M. grab, vanVeen grab and biological dredge for the "A study on the marine environmental atlas of the adjacent seas to Korea", and some other marine environmental studies conducted by Korea Ocean Research and Development Institute during the period from 1980 to 1985. The area for collection of ophiuran samples covered most of

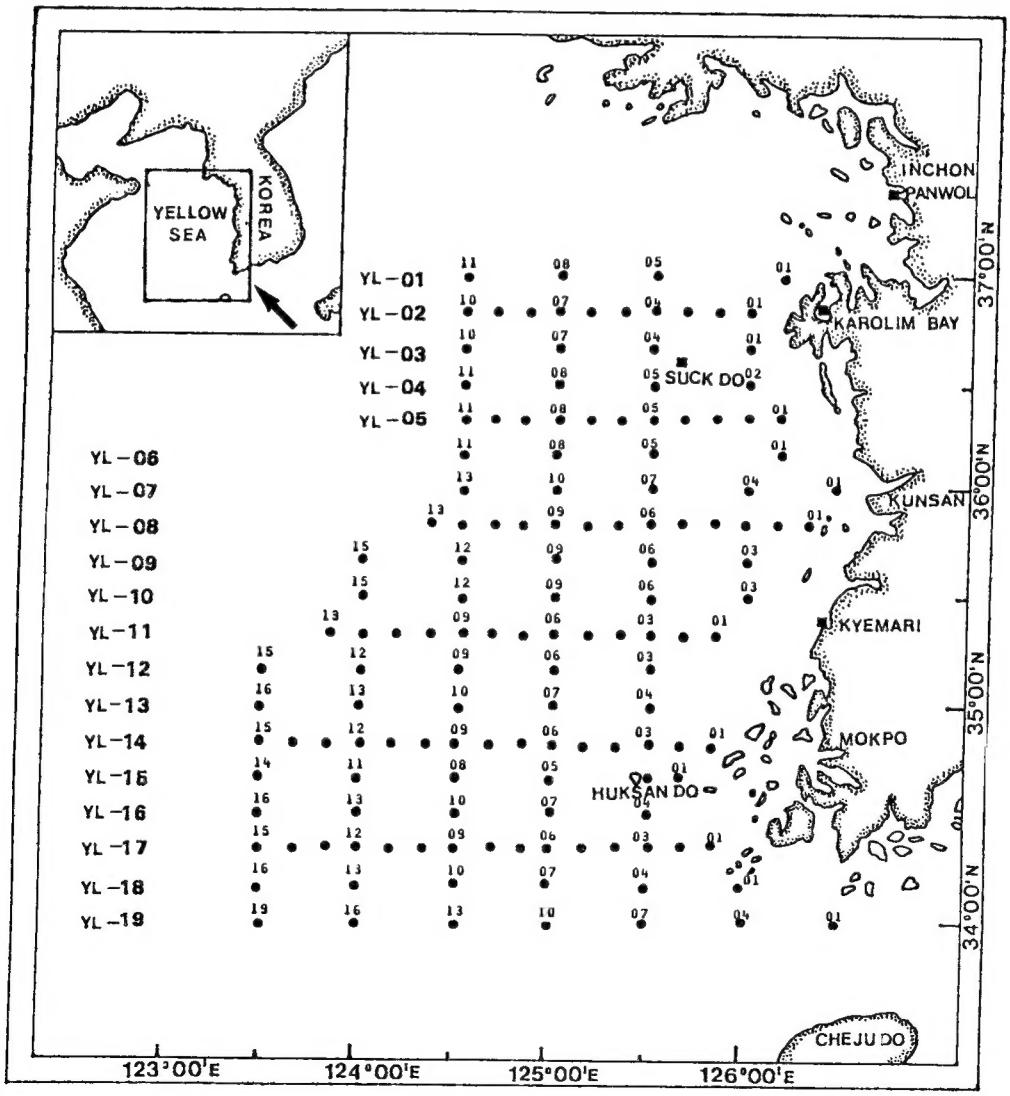

Fig. 1. Map showing the study area (●: sampling stations for "A study on the marine environmental atlas of the adjacent seas to Korea"; ■: sampling stations for the other marine environmental studies).

the eastern part of the Yellow Sea including the western coast of Korea, and one hundred and forty six stations were visited (Fig. 1).

RESULTS

Section 1. Key to the genera and species of Ophiuroidea in the Yellow Sea

1. Arms branched several times. Radial shield conspicuous. Arm spines confined to the ventral side. Oral papillae all similar and spiniform. Arms annulated by double rows of hooked granules (Family Gorgonocephalidae). Supplementary plates present between oral angles and interbrachial ventral surface. Arm spine absent, at least, within the first bifurcation. No peculiar marginal disc scale (Genus *Astrocladus*). Disc covered by dense granules. Disc and arms beset with a lot of scattered tubercles which conical or hemispherical. ..... *coniferus dofleini*
   Arms simple, not branched. 2
2. With a pair of infradental papillae on the apex of each jaw (Family Amphiuridae). 16
   Without a pair of infradental papillae. Apex of each jaw with a single papilla and/or cluster of tooth papillae. Dorsal arm plates not rudimentary. 3
3. Teeth broad, only a single infradental papilla on the apex of each jaw. Distal oral papillae well spaced. One large tentacle scale (Family Ophiactidae). 4
   Teeth round or conical. With a cluster papillae or a large infradental papilla. When distal oral papillae present, they shouldered together. 7
4. Distal oral papillae arising from the adoral shield. With one or a row of supplementary plates on the dorsal arm plates (Genus *Ophiopholis*). Disc covered thick scales and scattered conical and blunt tubercles. One large supplementary plate present on the each side of dorsal arm plates and also many small plates surrounded them. Four to five arm spines. Arm spines in the regenerated arms and younger individuals hooked. Three broad distal oral papillae and one tentacle scale. ..... *mirabilis*
   Oral papillae arising from the oral plate. No supplementary plate on the dorsal arm plates (Genus *Ophiactis*). 5
5. Five arms. Disc beset with a lot of scattered spines. Disc scales fine. Radial shields divergent by a row of three to four scales. Four arm spines. ..... *affinis*
   Six arms. 6
6. Radial shields divergent, meet only in distal part. Oral shields as wide as length. One (rerely two in some jaws) broad distal papilla. Three to four arm spines. ..... *profundi*
   Radial shields joined distally, at least, more than half of the length. One blunt distal papilla. Four arm spines. ..... *macrolepidota*
7. No oral papillae, only a cluster of tooth papillae present (Family Ophiotrichidae). Dorsal and ventral arm plates entire. Disc covered by dense spinelets or tubercles. Arm spines numerous, long, flattened and serrated (Genus *Ophiothrix*). 8
   Oral papillae present, usually one infradental and a few shouldered distal papillae. Arms only horizontally flexible. 9
8. Dorsal arm plates rhomboidal, slightly contact each other. First dorsal arm plate free from tuber-

cle or spine. Radial shields mostly naked ..... *koreana*
Dorsal arm plates rhomboidal, however wider than the another species of this couple. First dorsal arm plate beset with some spines. Radial shields closely beset with stout thorny spines or tubercles. ..... *exigua*

9. Disc covered by granules. No tooth papilla. Arms stout. Arm spines numerous (Family Ophiodermatidae). Two tentacle scales. More than six arm spines. Radial shields free of granules (Genus *Ophiarachnella*). Oral shields pentagonal, longer than width. One supplementary plate present just below the oral shields. Adoral shields very small, not meet each other. Eight to eleven arm spines. Two large and oval tentacle scales completely covered each tentacle pore. ..... *gorgonia*
Disc free of granule. 10

10. Arm spines long and erect. Teeth very stout, quadrangular with truncated end. No tooth papilla. Arms slender (Family Ophionereidae). Two large accessory dorsal arm plates present (Genus *Ophionereis*). Disc scales very fine. Genital papillae acute and erected, sometimes may be seen between the first dorsal arm plate and disc margin but not consist arm comb. Two tentacle scales, of which ventral side scale rudimentary. ..... *sasakii*
Arm spines short, lying flat on the arm. Arms short and stout (Family Ophiuridae). 11

11. Second oral tentacle pore openings within the oral slit. (Subfam. Ophiolepidinae). No arm comb. Tentacle pores present throught the entire length of the arm. Dorsal arm plates divided into many pieces (Genus *Ophioplocus*). Disc scales flat. Genital slit long. The dorsal arm plates divided into two halves, and separated each other by eight to ten larger supplementary plates and about same number of smaller plates. ..... *japonicus*
Second oral tentacle pore openings outside the oral slit (Subfam. Ophiurinae). 12

12. Disc high, covered by stout plates or thick scales. Arms higher than width. Dorsal arm plates very stout. Arms stout and short, rapidly tapered outward. Numerous arm spines present, arranged one or two rows (Genus *Stegophiura*). 13
Disc low and flat, not covered by stout plate but many scales of various size. Arms lower than width. Three arm spines (Genus *Ophiura*). Arm comb papillae long and slender, well spaced, eight to ten of them visible from above. ..... *kinbergi*

13. Arm spines dimorphic, arranged in two rows. 14
Arm spines subequal, arranged in one row. 15

14. Four to five primary arm spines and five to twelve secondary arm spines. Except the ventral most two papillae which large and fused together, the secondary papillae well spaced. ..... *sterea*
Three erect primary arm spines. Two of which place near ventral plate and between these two primaries, one wide and squarish secondary spine present. Remaning all secondary spines narrow and shouldered together. ..... *sladeni*

15. Radial shields of the same radius overlapping each other. Seven to eight arm spines including tentacle scales. ..... *vivipara*
Radial shields of the same radius not overlapping, but joined each other. Eight arm spines near the arm base. ..... *sculpta*

16. Oral papillae do not forming a continuous row, so that a wide space between the infradental papilla and one or two distal papillae on the each side of jaw. Oral formula; m, o, mo+t or m, om$\widehat{\text{n}}$+t (Genus *Amphiura*). 17

Oral papillae forming a continuous row, so that the oral slit more or less completely closed. 21

17. Tentacle scales, one or two, present. 18
    Tentacle scale absent. 19
18. Two tentacle scales. Two distal papillae on the each side of jaw. Radial shields large, more than twice as long as width, divergent by a row of three scales which larger than other disc scales. ..... *koreae*
    One tentacle scale. One large and ovate distal papilla. Tentacle scale also large and ovate, more or less subequal to distal papilla. Disc covered by imbricated scales. Radial shields pear shaped, separated each other. Primaries distinct. Ventral scales finer than disc scales. Four arm spines. ..... *iridoides*
19. Disc covered by fine scales. Scales around the radial shields bigger than the other region. Radial shields large and narrow. One large infradental papilla and erected, spine-like distal papilla. Four to five arm spines. ..... *syntharacha*
    Disc naked except around the radial shields. Radial shields wide. Arms long. 20
20. Four or five arm spines at arm base, arms ten to twelve times as long as disc diameter. ..... *aestuarii*
    Six to seven arm spines at arm base, arms very long, more than thirty times as long as disc diameter. ..... *vadicola*
21. With an additional papilla just outside and above the infradental one. Oral formula; m, m $\widehat{n}$ m+t (Genus *Amphioplus*). 22
    Without an additional papilla. Outermost distal papilla the largest, very wide and operculiform. Oral formular; m, m $\widehat{N,N}$ - t (Genus *Amphipholis*). 24
22. Radial shields very wide, about twice as long as width, completely joined. With special marginal scales on the disc, sometimes microscopically serrated at the edges. Three arm spines. Four oral papillae on the each side of the jaw, among them the third the largest and widest. Two large tentacle scales. ..... *megapomus*
    Radial shields narrow, divergent in a certain degree. 23
23. Three subequal arm spines. Radial shields long and narrow, about four times longer than width. Four oral papillae in a close series, the distalmost the largest. ..... *asterictus*
    Four to six arm spines, second or third spines hooked and glassily at the tip. Radial shields about thrice longer than width. Outer end of genital plate bearing a small projection distally to the radial shield, the projection macroscopically branched. ..... *ancistrotus*
24. Radial shields two and half times as long as width. Three arm spines, the lowest the shortest. ..... *squamata*
    Radial shields very wide, about twice as long as width. Three arm spines, the middle spine the shortest. ..... *sobrina*

Section 2. List of species of Ophiuroidea in the Yellow Sea

Family Gorgonocephalidae Ljungman, 1868

1. *Astrocladus coniferus dofleini* (Döderlein, 1902) 보통돌가시거미불가사리

Family Ophiactidae Matsumoto, 1915

2. *Ophiopholis mirabilis* (Duncan, 1879) 뿔거미불가사리

3. *Ophiactis profundi* Lütken & Mortensen, 1899 깊은뱀이거미불가사리
4. *Ophiactis affinis* Duncan, 1879 유사뱀이거미불가사리
5. *Ophiactis macrolepidota* Marktanner-Turneretscher, 1887 예쁜뱀이거미불가사리

Family Amphiuridae Ljungman, 1867

6. *Amphiura (Amphiura) koreae* Duncan, 1879 털뱀거미불가사리
7. **Amphiura (Amphiura) iridoides* Matsumoto, 1917 둥근팔비늘거미불가사리(신칭)
8. **Amphiura (Amphiura) syntharacha* H.L. Clark, 1915 잔비늘거미불가사리(신칭)
9. *Amphiura (Fellaria) vadicola* Matsumoto, 1915 채찍팔거미불가사리
10. *Amphiura (Ophiopeltis) aestuarii* Matsumoto, 1915 아기팔거미불가사리
11. *Amphioplus (Lymanella) megapomus* H.L. Clark, 1911 넓은팔비늘거미불가사리
12. **Amphioplus (Amphioplus) astericus* H.L. Clark, 1915 세가시거미불가사리(신칭)
13. *Amphioplus (Amphioplus) ancistrotus* (H.L. Clark, 1911) 뿔가시거미불가사리
14. *Amphipholis squamata* (Delle Chiaje, 1829) 세이빨거미불가사리
15. *Amphipholis sobrina* Matsumoto, 1917 납작거미불가사리

Family Ophiothricidae Ljungman, 1866

16. *Ophiothrix koreana* Duncan, 1879 고려가시거미불가사리
17. *Ophiothrix (Ophiothrix) exigua* Lyman, 1874 짧은가시거미불가사리

Family Ophiodermatidae Ljungman, 1867

18. *Ophiarachnella gorgonia* (Müller & Troschel, 1842) 뱀거미불가사리

Family Ophionereidae Lütken, 1859

19. **Ophionereis sasakii* (A.M. Clark, 1953) 사사끼거미불가사리(신칭)

Family Ophiuridae Lyman, 1865

Subfamily Ophiolepidinae Matsumoto, 1915

20. *Ophioplocus japonicus* H.L. Clark, 1911 왜곱슬거미불가사리

Subfamily Ophiurinae Lyman, 1865

21. *Stegophiura sterea* (H L. Clark, 1908) 톱가시지붕거미불가사리(신칭)
22. *Stegophiura sladeni* (Duncan, 1879) 슬라덴지붕거미불가사리
23. **Stegophiura vivipara* Matsumoto, 1915 아기지붕거미불가사리(신칭)
24. *Stegophiura sculpta* (Duncan, 1879) 잔가시지붕거미불가사리(신칭)
25. *Ophiura kinbergi* (Ljungman, 1866) 빗살거미불가사리

* New record species in the Korean waters.

Section 3. Description of species of Ophiuroidea in the Yellow Sea

Family Gorgonocephalidae Ljungman, 1868

1. Astrocladus coniferus dofleini (Döderlein, 1902) (Fig. 2)

Astrocladus dofleini Döderlein 1911 (p. 41); Bomford, 1913 (p. 200).

Astrocladus coniferus var. *dofleini* Matsumoto, 1917 (p. 77); Irimura, 1979 (p. 2); 1981 (p. 19); 1982 (p. 11).

Specimens examined: Huksando, 1984, 6 specimens.

Remarks: Matsumoto (1917) pointed out that there were no remarkable differences among *A. coniferus, A. dofleini* and *A. pardalis*. However, present specimens well agreed with *A. dofleini* of Döderlein's (1911) which was considered to be a variety of *A. coniferus* by Matsumoto (1917). Other specimens in the authors collection (two specimens from Chejudo and one specimen from Pijindo,

southern coast of Korea) are also referrable to the category of *A. dofleini* type even they have some variations in the number and distribution of the tubercles.

Distribution: Korea [Yellow Sea (Huksando), Chejudo, southern coast (Pijindo), Pusan, Korea Strait, East Sea], other (Japan, East China, Peter the Great Bay, Philippines).

Size: Disc diameter, up to 5*cm*; Busket diameter, 18*cm*.

Ecology: Subtidal hard bottom, sometimes can be seen between large rock in the intertidal zone.

Family Ophiactidae Matsumoto, 1915

2. *Ophiopholis mirabilis* (Duncan, 1879)

Ophiolepis mirabilis Duncan 1879 (p. 460).

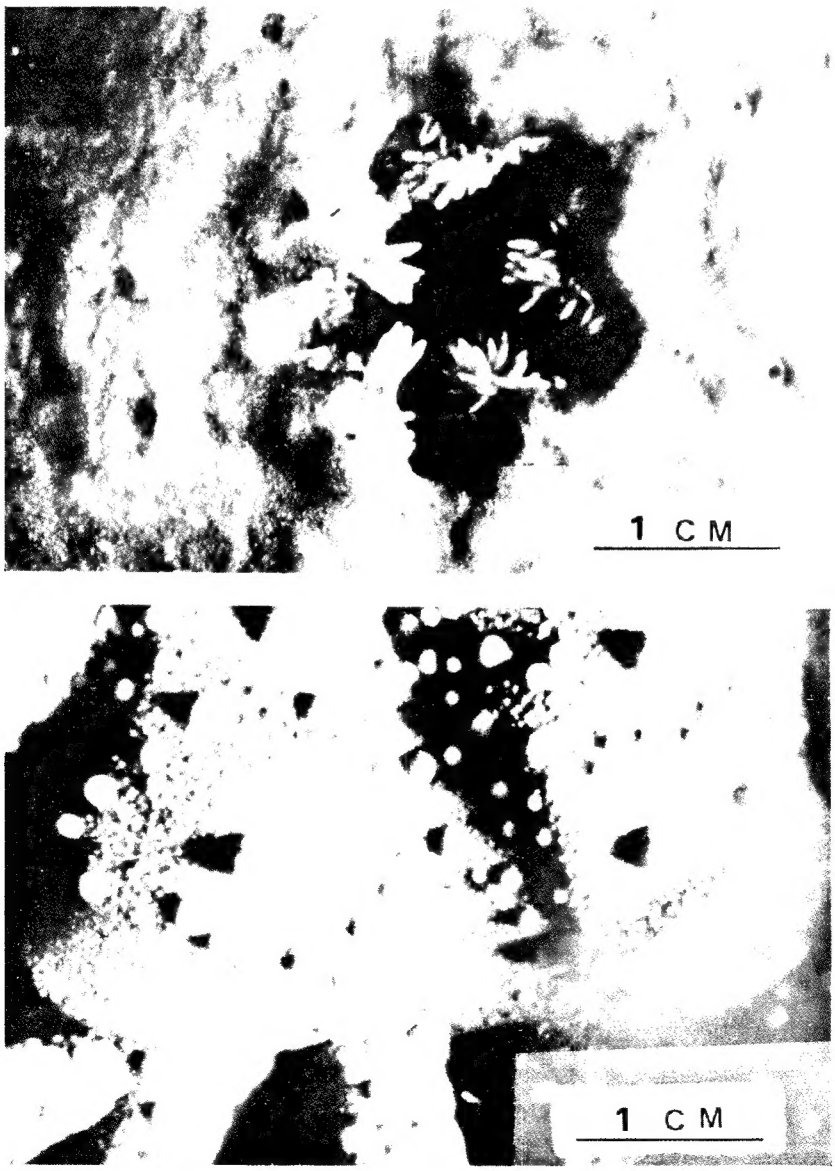

Fig. 2. Ventral and dorsal view of *Astrocladus coniferus dofleini.*

Ophiopholis mirabilis: Lyman, 1879 (p. 43); 1882 (p. 115); Köehler, 1909 (p. 168); H.L. Clark, 1911 (p. 117); Matsumoto, 1917 (p. 160); 1918 (p. 478); 1941 (p. 332); D'yakonov, 1949 (p. 53); 1954 (p. 54); Irimura, 1982 (p. 29); Rho, 1979 (p. 46).

Specimens examined: YL-01-08, 1982, 2 specimens; YL-02-05, 1983 3 specimens; YL-02-07, 1983, 7 specimens; YL-02-09, 1983, 2 specimens; YL-03-10, 1984, 3 specimens; YL-04-08, 1982, 2 specimens; YL-04-11, 1982, 1 specimens; YL-05-07, 1983, 2 specimens; YL-06-08, 1984, 3 specimens; YL-07-10, 1982, 39 specimens; YL-08-04, 1982, 23 specimens; YL-09-03, 1984, 1 specimens; YL-09-06, 1984, 8 specimens; YL-09-09, 1984, 42 specimens; YL-12-03, 1984, 1 specimens; YL-13-04, 1982, 23 specimens; YL-15-14, 1984, 1 specimens; YL-18-04, 1984, 91 specimens; YL-18-07, 1985, 16 specimens; Yellow Sea (by trawl net), 1982-1984, numerous specimens; near Huksando, 1984 (by dredge), 23 specimens; Karolim Bay (by dredge), 1981, numerous specimens.

Distribution: Korea (All part of the Korean waters), others (Southern Okhotsk, Japan).

Size: Disc diameter, max. 1*cm*; Arm length, 1.2-1.5*cm*.

Ecology: Common in muddy sand to sand bottoms bellow low tidal level, 10-70*m* in depth, one of the abundant species in Korean waters.

3. Ophiactis profundi Lütken & Mortensen, 1899. (Fig. 3)

Ophiactis profundi Lütken & Mortensen, 1899 (p. 140); Köehler, 1922 (p. 192); Murakami, 1963 (p. 173); Irimura 1981 (p. 22).

Ophiactis pteropona H.L. Clark, 1911 (p. 134); Matsumoto, 1917 (p. 154); Shin, 1984 (p. 51).

Remarks: The present specimens well coincide with Köehler (1922) except they have four arm spines in some basal arm segments. Such characteristics also can be found in the specimens from Toyama-Bay in Japan. All of the present specimens have three smaller and three larger arms. And this feature is derived by the process of schizogony of the animals.

H.L. Clark (1911) established *O. pteropoma* based on the shape of upper arm spines. However, this characteristic is very much variable in the Genus *Ophiactis*. Matsumoto (1917) and Köehler (1922) noted that *O. pteropoma* is extremely close to *O. profundi*. To put *O. pteropoma* as a synonym of *O. profundi*, the holotype of the two species should be reexamined. However judging from the external

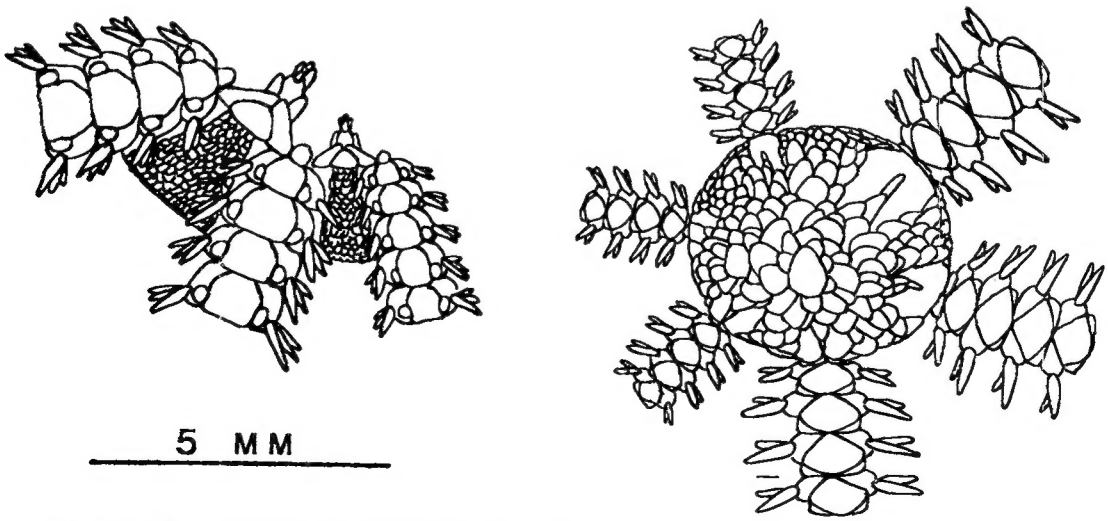

Fig. 3. Ventral and dorsal view of *Ophiactis profundi*.

variations of the present specimens, *O. pteroponia* fall within the specific variation of *O. profundi*. Furthermore it seems that *O. dyscrita, O. brachyaspis* and *O. brachygenys* are possibly synonym of *O. profundi*.

Distribution: Korea (Yellow Sea, East Sea), others [Japan (Tanabe Bay, Uraga Channel, Misaki, Kii, Tsugaru Channel)]

Size: Disc diameter, 4*mm*; Arm length, about 1.3*cm*

Ecology: Muddy sand to fine sand bottom, 30-80*m* in depth.

4. Ophiactis affinis Duncan, 1879

Ophiactis affinis Duncan, 1879 (p. 469); Lyman, 1882 (p. 115); H.L. Clark, 1915 (p. 266); Matsumoto, 1917 (p. 155); Smith, 1927 (p. 272); Köehler, 1930 (p. 121); Chang, 1948 (p. 50); Lee, 1971 (p. 24); Irimura, 1981 (p. 21).

Specimens examined: Kalorim Bay, 1982, 6 specimens; YL-08-10, 1983, 3 specimens; YL-03-10, 1984, 2 specimens; YL-18-01, 1983, 4 specimens.

Distribution: Korea (Yellow Sea, Korea Strait, southern coast), others (Japan, Philippine, Banda, Sea, China, San Juanico St.).

Size: Disc diameter. 4*mm*; Arm length, 1.6*cm*.

Ecology: Fine sand to muddy sand bottom, 50-60m in depth.

5. Ophiactis macrolepidota Marktanner-Turneretscher, 1887

Ophiactis macrolepidota Marktanner-Turneretshcer, 1887 (p. 298); Matsumoto, 1917 (p. 155); H.L. Clark, 1918 (p. 302); 1946 (p. 209); Murakami, 1942 (p. 8); 1943a (p. 167); A.M. Clark, 1965 (p. 41); Irimura, 1969 (p. 40); 1981 (p. 22); Rho, 1979 (p. 13).

Specimens examined: YL-03-10, 1984, 4 specimens; Karolim Bay, 1982, 2 specimens.

Distribution: Korea (Yellow Sea, southern coast, Pusan), others (Janpan, Palau Is. Caroline Is., Noth Australia).

Size: Disc diameter, 4*mm*; Arm length, 6*mm*.

Ecology: Shell and fine gravel bottom, 10-80*m* in depth.

Family Amphiuridae Ljungman, 1867

6. Amphiura (Amphiura) koreae Duncan, 1879

Amphiura Koreae Duncan, 1879 (p. 466); Matsumoto, 1917 (p. 198); Fell, 1962 (p. 22); D'yakonov, 1954 (p. 71); A. M. Clark, 1965 (p. 47); 1970 (p. 41); Lee, 1971 (p. 37); Rho, 1979 (p. 43); Yi, 1983 (p. 11).

Amphiura diomedeae H. L. Clark, 1911 (p. 140); 1917 (p. 436); 1939b (p. 56); Fell, 1962 (p. 21); Downey, 1969 (p. 26); A. M. Clark 1970 (p. 41).

Amphiura coreae Lyman, 1882 (p. 146); H. L. Clark, 1915 (p. 234).

Specimens examined: YL-16-07, 1982, 1 specimen; YL-18-04, 1982, 12 specimens; YL-19-16, 1982, 2 specimens.

Distribution: Korea (Yellow Sea, Chejudo, Korea Strait, Pusan), others (Japan, Tahiti, Peru, Pacific coast of Central America, South Arabian Coast, Malaysia).

Size: Disc diameter, 7*mm*; Arm length, 1.5*cm*.

Ecology: Muddy sand to fine sand bottoms, subtidal to 90*m*.

7. Amphiura (Amphiura) iridoides Matsumoto, 1917 (Fig. 4)

Amphiura iridoides Matsumoto, 1917 (p. 205); A. M. Clark, 1965 (p. 43).

Monamphiura iridoides: Fell, 1962 (p. 22); Irimura, 1969 (p. 41); Kikuchi, 1977 (p. 127).

Specimens examined: YL-17-04, 1983, 2 speciemens; YL-18-04, 1984, 2 specimens.

Distribution: Korea (Yellow Sea), others (Japan, Philippine).

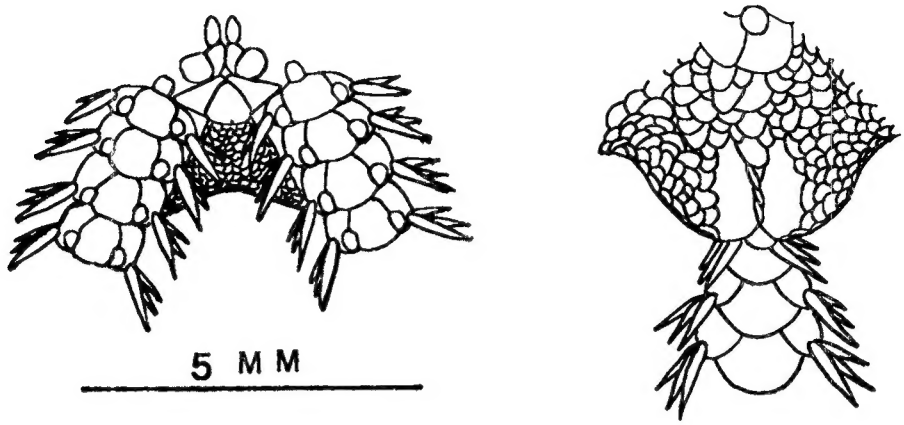

Fig. 4. Ventral and dorsal view of *Amphiura iridoides.*

Size: Disc diameter, 4*mm*; Arm length, about 1.5*cm* based on broken arm.

Ecology: Muddy sand bottom, 40*m* in depth.

Remarks: The present specimens differ to Matsumoto (1917) in the shape of arm spines. They have rather conical arm spines instead of flattened ones. And the maximum length of the longest arm spine is only about 1.5 times of corresponding arm segment. In this sence of view, the present specimens are close to *A. iris.* A. M. Clark (1965) noted that one of her specimens of *A. iridoides* approches *A. iris* in having the distal oral papillae thicker than Matsumoto's (1917) description of *A. iridoides.* And her description of *A. iris* and *A. iridoides* were not exactly meet the orignal description (Lyman 1879, 1882, Matsumoto 1917). Furthermore the number of arm spines of A. M. Clark's (1965) specimen were six while Matsumoto's (1917) were five. Therefore detail examinations of external characteristic of these two species are required.

The six primaries seemed to be a characteristic of young stage.

8. Amphira (Amphiura) syntaracha H. L. Clark, 1915 (Fig. 5)

Amphiura syntaracha H. L. Clark, 1915 (p. 232), Murakani, 1944b (p. 266); A. M. Clark, 1970 (p. 11); Downey, 1969 (p. 38); Irimura, 1979 (p. 3).

Icalia syntaracha: Fell, 1962 (p. 26); Irimura, 1969 (p. 42).

Specimens examined: Kyemari, 1985, 5 specimens; Inchon, 1981, 1 specimen.

Remarks: The present specimens coincide well to Murakami (1944).

H. L. Clark (1915) noted that the radial shields of his specimens are long and narrow, however his photographs showed some what wide radial shields. And he missed to comment the microscophical serrations on the widest spines. The degree of coverness of ventral side by scales are variable among the specimens.

Distribution: Korea (Yellow Sea, Hansando), other (Japan).

Size: Disc diameter, 1*cm*; Arm length, 5*cm.*

Ecology: Muddy bottom, subtidal.

9. Amphiura (Fellaria) vadicola Matsumoto, 1915

Amphiura vadicola Matsumoto, 1915 (p. 71); 1917 (p. 211); H. L. Clark, 1915 (p. 235); Irimura, 1981 (p. 26).

Ophiopeltis vadicola: Fell, 1962 (p. 26); Kikuchi, 1977 (p. 127); Lee, 1971 (p. 41).

Amphiura (Fellaria) vadicola: A. M. Clark, 1970 (p. 18); Yi, 1983 (p. 11).

Specimens examined: Panweol, 1980, 6 specimens; YL-10-04 1982, 4 specimens.

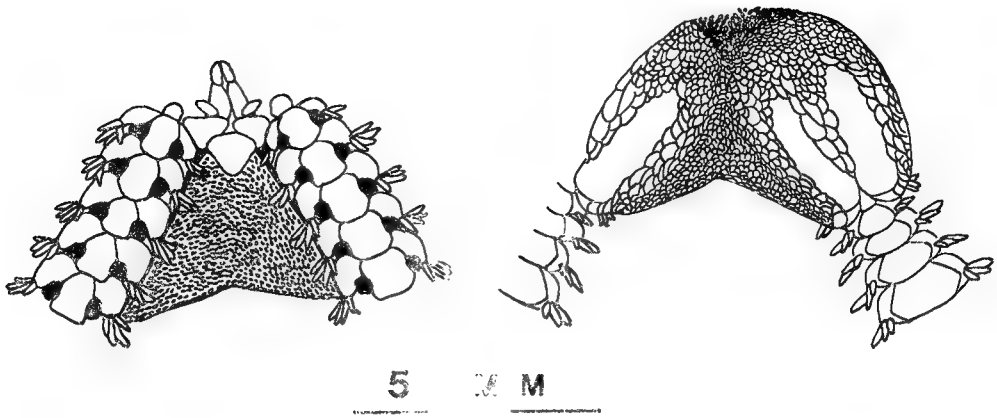

Fig. 5. Ventral and dorsal view of *Amphiura syntharacha*.

Distribution: Korea (Yellow Sea, southern coast), others (Japan).

Size: Disc diameter, 7*mm*; Arm length, 8.5*cm*.

Ecology: Silty sand to very fine sand, 20-30*m* in depth.

10. Amphiura (Ophiopeltis) aestuarii Matsumoto, 1915

Amphiura aestuarii Matsumoto, 1915 (p. 73); 1917 (p. 208); H. L. Clark, 1915 (p. 233); Murakami, 1944b (p. 265).

Ophiopeltis aestuarii: Fell, 1962 (p. 18); Kikuchi, 1977 (p. 127).

Amphiura (Ophiopeltis) aestuarii: A. M. Clark, 1970 (p. 18); Yi, 1983 (p. 12).

Specimens examined: YL-19-10 1981, 4 specimens.

Distribution: Korea (Yellow Sea, southern coast), others (Japan).

Size: Disc diameter, 3*mm*; Arm length, about 3.2*cm*.

Ecology: Muddy sand to fine sand, 10-80*m* in depth.

11. Amphioplus (Lymanella) megapomus H. L. Clark, 1911

Amphioplus megapomus H. L. Clark, 1911 (p. 170); 1915 (p. 255); Matsumoto, 1917 (p. 170); Fell, 1962 (p. 23); Downey, 1969 (p. 15); Irimura, 1981 (p. 25).

Amphioplus miyadi Murakami, 1943b (p. 233); 1963 (p. 175); Kikuchi, 1977 (p 141).

Amphioplus (Lymanella) megapomus: A. M. Clark, 1970 (p. 46, 52); Yi, 1983 (p. 14).

Specimens examined: YL-02-10, 1984, 2 specimens; YL-02-04, 1984, 1 specimen; YL-03-10, 1984, 68 specimens; YL-02-04, 1982, 435 specimens; YL-06-02, 1984, 3 specimens; YL-07-01, 1982, 1 specimen; YL-09-03, 1984, 5 specimens; YL-12-03, 1984, 14 specimens; YL-13-04, 1982, 4 specimens; YL-15-08, 1984, 1 specimen; YL-16-07, 1982, 1 specimen; YL-18-04, 1984, 4 specimens; YL-19-10, 1982, 1 specimen; Yellow Sea (by trawl net), 1984, 36 specimens; near Huksando (by dredge), 1984, 216 specimens

Distribution: Korea (Yellow Sea, southern coast, southeastern coast), other (Japan).

Size: Disc diameter, 7*mm*; Arm length, about 8*cm*.

Ecology: Mud to fine sand bottoms, 10-80*m* in depth.

12. Amphioplus (Amphioplus) asterictus H. L Clark, 1915 (Fig. 6)

Amphioplus asterictus H. L. Clark, 1915 (p. 252); A. M. Clark, 1965 (p. 54); Downey 1969 (p. 13).

Amphioplus (Amphioplus) asterictus: A. M. Clark, 1970 (p. 56).

Specimens examined: near Huksando 1984, 4 specimens.

Remarks: H. L. Clark (1915) noted that the distalmost oral papilla is the largest of all and nearly

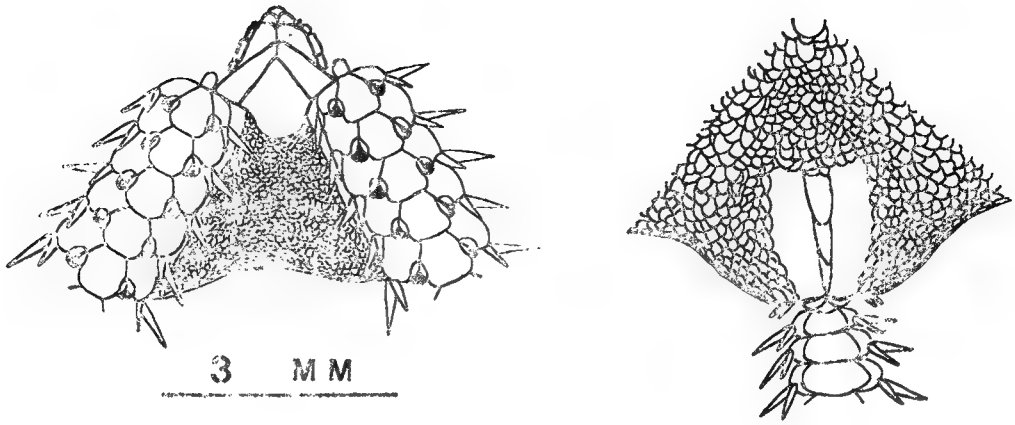

Fig. 6. Ventral and dorsal view of *Amphioplus astericlus*.

equal to the first ventral arm plate. However, the present specimens have large second distal oral papilla which is about thrice larger than the first ventral arm plate. There are also some variations of the oral papillae arrangement, but largest distalmost papilla is not included. Except for this character, the present specimens are well agree with the description by H. L. Clark (1915).

Distribution: Korea (Yellow Sea, Ulsan), others (Japan).

Size: Disc diameter, 7*mm*; Arm length, about 8*cm*.

Ecology: Mud to fine sand bottoms, 20-50*m* in depth.

13. Amphioplus (Amphioplus) ancistrotus (H. L. Clark, 1911)

Amphiodia ancistrota H. L. Clark, 1911 (p. 161); 1915 (p. 245); Downey, 1969 (p. 3).

Amphioplus lobatodes H. L. Clark, 1915 (p. 254).

Amphioplus ancistrotus: Matsumoto, 1917 (p. 171); Murakami, 1942 (p. 9); Chang, 1948 (p. 54); D'yakonov, 1954 (p. 61); Fell, 1962 (p. 19); A. M. Clark, 1965 (p. 51).

Amphioplus (Amphioplus) ancistrotus: A. M. Clark, 1970 (p. 56); Irimura, 1982 (p. 32); Yi, 1983 (p. 13).

Specimens examined: YL-06-02, 1984, 1 specimen; YL-19-10, 1982, 2 specimens; YL-19-16, 1982, 2 speciemens; YL-12-01, 1984, 1 specimen.

Distribution: Korea (Yellow Sea, southern coast), others (Japan, China).

Size: Disc diameter, 1.2*cm*; Arm length, 11.3*cm*.

Ecology: Mud to fine sand bottoms, 10-90*m* in depth.

14. Amphipholis squamata (Delle Chiaje, 1829)

Amphipholis squamata Köehler, 1914 (p. 66); 1921 (p. 82); H. L. Clark, 1915 (p. 242); 1938 (p. 243); Mortensen, 1927 (p. 221); 1936 (p. 292); H. L. Clark, 1939a (p. 2); Ely, 1942 (p. 46); D'yakonov, 1954 (p. 65); Fell, 1962 (p. 25); A. M. Clark, 1970 (p. 29); A. M. Clark and Rowe, 1971 (p. 39); A. M. Clark and Courtman-Stock, 1976 (p. 151); Liao, 1978 (p. 71); Irimura, 1982 (p. 41); Gage *et al.*, 1983 (p. 269); Paterson, 1985 (p. 84).

Amphipholis japonica Matsumoto, 1915 (p. 71); 1917 (p. 186); H. L. Clark, 1915 (p. 241); Fell, 1962 (p. 22); Downey, 1969 (p. 17); Irimura, 1979 (p. 3); 1981 (p. 25); Yi, 1983 (p. 14).

Specimens examined: YL-07-01, 1981, 7 specimens; YL-15-01, 1983, 1 specimen; Suckdo, 1983, 1 specimen, Hongdo, 1983, 9 specimens, Huksando, 1983, 9 specimens; 1984, 3 specimens (by dredge).

Distribution: Korea (Yellow Sea), others (Cosmopolitan).

Size: Disc diameter, 3*mm*; Arm length, 1.1*cm*.

Ecology: Intertidal to deep sea, hard bottom, gravely sand bottom, 0-1330*m* in depth.

15. Amphipholis sobrina Matsumoto, 1917

Amphipholis sobrina Matsumoto, 1917 (p. 189); Fell, 1962 (p. 24); Rho, 1979 (p. 10); Yi, 1983 (p. 14).

Specimens examined: YL-07-10, 1984, 2 specimens; YL-07-01, 1984, 1 specimen.

Distribution: Korea (Yellow Sea, Korea Strait, Pusan), others (Japan).

Size: Disc diameter, 4*mm*; Arm length, 1.2*cm*.

Ecology: Mud to fine sand bottoms, 20-70*m* in depth.

Family Ophiothricidae Ljungman, 1866

16. Ophiothrix Koreana Duncan, 1879

Ophiothrix koreana Duncan, 1879 (p. 473); Lyman, 1882 (p. 226); Marktanner-Turneretscher, 1887 (p. 308); H. L. Clark, 1911 (p. 257); Matsumoto, 1917 (p. 220); Murakami, 1942 (p. 20); 1943c (p. 232); 1944b (p. 267); 1963 (p. 176); D'yakonov, 1954 (p. 88); A. M. Clark, 1965 (p. 61); 1967 (p. 647); Rho and Kim, 1966 (p. 285); Irimura, 1979 (p. 3); 1981 (p. 29).

Ophiothrix panchyendyta H. L. Clark, 1911 (p. 264); Matsumoto, 1917 (p. 219); A.M. Clark, 1965 (p. 62); Irimura, 1982 (p. 47).

Ophiothrix eusteira H. L. Clark, 1911 (p. 265), Matsumoto, 1917 (p. 222), A. M. Clark, 1965 (p. 60).

Ophiothrix abstinens Köehler, 1930 (p. 153); A. M. Clark and Rowe, 1971 (p. 84).

Specimens examined: YL-03-10, 1984, 2 specimens; Karolim Bay, 1981, 18 specimens.

Remarks: There are many difficulties in the identification of species belonging to the Gen. *Ophiothrix* in the East Asian waters, especially those having almost bare radial shields such as *O. koreana, O. panchyendyta, O. eusteira* and *O. abstinens*. This is due to Duncan's (1879) incorrect description and figures of *O. koreana*.

H. L. Clark (1911) figured *O. koreana* based on Albatross collection and not coincide with Duncan's figure. Subseqnently, A.M. Clark (1965) noted that many of Duncan's syntypes are covered with stumps on their radial shields and concluded that the form of stumps can not be considered as diagnostic. Otherwise they should be identified as *O. stelligera* or *O. exigua*. This was also approved by Irimura (1981, 1982).

It seemed that previous authors (Duncan, 1879; H. L. Clark, 1911; Matsumoto, 1917; Köehler, 1922) dealt with the species from East Asian waters without comparing to any other species belonging to the Gen. *Ophiothrix* from the Indo-West Pacific waters.

Therefore, a critical reexamination of known species of Gen. *Ophiothrix* should be given in order to select the lectotype of *O. koreana* from Duncan's syntypes.

The present specimens have more or less naked radial shields and are tentatively identified as *O. koreana* based on the Mutsumoto (1917). A much larger collection than that available at present is required before the proper identification of the species is made.

Distribution: Korea (Yellow Sea, southern coast, Korea Strait, eastern coast), others (Japan, East China, Banda Sea, Amboina, Philippines).

Size: Disc diameter, 9*mm*; Arm length, 5*cm*.

Ecology: Common in shell gravel and hard bottom, subtidal to 80*m* in depth.

17. Ophiothrix (Ophiothrix) exigua (Lyman, 1874)

Ophiothrix exigua Lyman, 1874 (p. 236); 1882 (p. 217); Köehler, 1905a (p. 86); 1905b (p. 458);1907 (p. 332); 1922 (p. 228); 1930 (p. 139); H. L. Clark, 1915 (p. 272); 1938 (p. 273); Mortensen, 1934 (p. 10); A. H. Clark, 1952 (p. 293); A. M. Clark, 1967b (p. 647); A.M. Clark & Rowe, 1971 (p. 110); Cherbonnier & Guille, 1978 (p. 140); Guille & Jangoux, 1978 (p. 61); Irimura, 1981 (p. 28); 1982 (p. 43).

Ophiothrix koreana Duncan, 1879 [p. 473 (par.)].

Ophiothrix stelligera Marktanner-Turneretscher, 1887 [p. 310 (non Lyman)].

Ophiothrix marenzelleri Köehler, 1904b (p. 103); Matsumoto, 1917 (p. 220); 1918 (p. 478); Köehler, 1922 (p. 248); Matsumoto, 1941 (p. 342); Murakami, 1943c (p. 233); 1944b (p. 267); 1963 (p. 176); A. M. Clark, 1967b (p. 647): Irimura, 1969 (p. 43); 1979 (p. 4).

Ophiothrix hylodes H. L. Clark, 1911 (p. 263).

Specimens examined: Suckdo (Yellow Sea) 1982, 3 specimens.

Distribution: Korea (Yellow Sea, Pusan), others (Japan, East China Sea).

Size: About same size to *Ophiothrix koreana.*

Ecology: Subtidal hard botom, 10-20*m* in depth.

Family Ophiodermatidae Ljungman, 1867

18. *Ophiarachnella gorgonia* (Müller et Troschel, 1842)

Pectinura gorgonia: Lyman, 1879 (p. 49); 1882 (p. 298).

Ophiarachnella gorgonia: H. L. Clark, 1909 (p. 128); Matsumoto, 1917 (p. 323); Murakami, 1942 (p. 33); 1943a (p. 187); 1943b (p. 214); 1944b (p. 272); A. M. Clark, 1965 (p. 66); A. M. Clark and Rowe, 1971 (p. 125); Irimura, 1969 (p. 45); 1979 (p. 5); 1981 (p. 43); 1982 (p. 66); Lee, 1971 (p. 61); Kikuchi, 1977 (p. 128); Liao, 1978 (p. 93); Rho, 1979 (p. 4).

Specimens examined: Huksando 1983, 2 specimens.

Distribution: Korea (Huksando, Chejudo), othres (Japan, Indo-West Pacific area)

Size: Disc diameter, 2.4*cm*; Arm length, 9.6*cm*.

Ecology: Intertidal to subtidal hard bottom.

Family Ophionereidae Lütken, 1859

19. *Ophionereis sasakii* A. M. Clark, 1953 (Fig. 7)

Ophionereis sasakii A. M. Clark, 1953 (p. 76).

Specimens examined: YL-18-04, 1984, 3 specimens

Description: The first description of this species was incomplete, since it was based on a single dried specimen. A knew description was given here. Disc covered by very fine scales. Dics scales rather coarse at arround radial shields. Radial shields very small, one fifth as long as disc radius, and

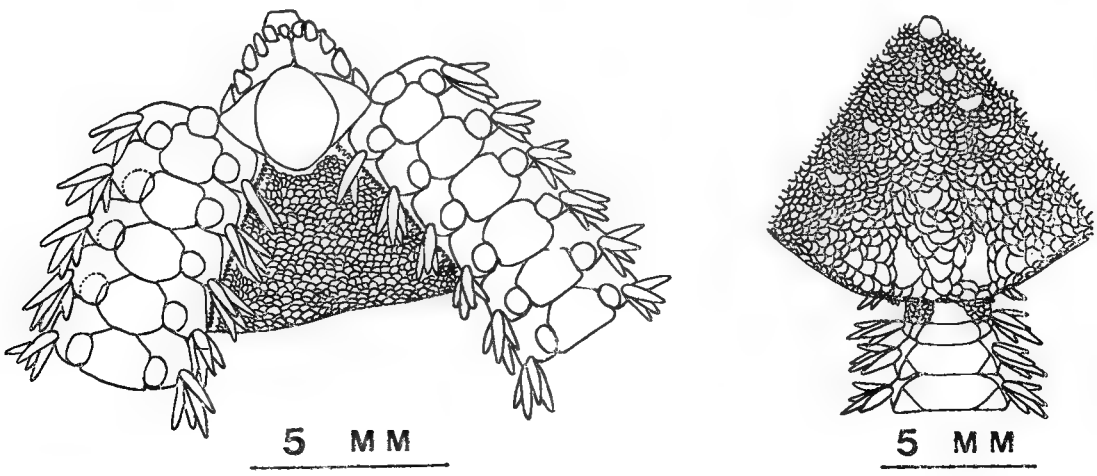

Fig. 7. Ventral and dorsal view of *Ophionereis sasakii.*

twice as long as width. Separated from each other. First dorsal arm plate very small and sometimes concealed more than half of the plate by disc scales. The second plate as large as two thirds of the following plates. Dorsal arm plates in the middle of the arms hexagonal, about two and half times wider than length. Supplementary arm plates as large as two thirds of the side arm plates. Purple annulation consisted by pigment present on the every three to five arm segments. Side arm plates carry four stout arm spines proximally and become three distally. The second from the top the largest when the number four, and the first the largest when three. Side arm plates not meet following plates. Oral shields large and oval, longer than width. Adoral shields small, not meet each other. Four to six oral papilla shouldered together. The first ventral arm plates rather small, wider than long. The second plates slightly smaller than following plates and wider than length. Remaining plates pentagonal, wider than length or as wide as length. Slightly contact following plates. One large and oval tentacle scales to each tentacle pore. Beside this, one small narrow scale like projection (rudiment of second tentacle scale?) present on the lateral edge of ventral arm plate under each larger tentacle scale. Genital papilla acute and erected. Some of the papillae can be seen just below the radial shields (Fig. 7).

Remarks: The present specimens generally agreed with *O. sasakii* (A. M. Clark 1953), however quite similar to *O. eurybrachyplax* (A. H. Clark 1911) in many ways. A. M. Clark (1953) noted that *O. sasakii* differs from *O. eurybrachyplax* in shape of oral shields, number of tentacle scales and arrangement of genital papillae. The oral frames of the present specimens are variable in certain degrees and showed intermediate feature between *O. sasakii* (A. M. Clark 1953) and *O. eurybrachyplax* (H. L. Clark 1911). The number of tentacle scales may be questionable character. When a large and oval tentacle scales is displaced, there is a scale like projection on the lateral edge of the ventral arm plate. The projections in some tentacle pores are quite apparent and may be the secondary tentacle scale, however majority of them are rudimentary. The only remaining diagnostic character of these two species is the arrangement of the genital papillae. In *O. sasakii*, the genital papillae continue up onto the dorsal side of the disc around the arm bases as arm combs. Some of the genital papillae can be seen in the present specimens like *O. eurybrachyplax*. These visible genital papillae from above may derived from unusual overturn of the genital slit due to malpreservation.

Distribution: Korea (Yellow Sea, Ulsan), others (Japan, California).

Size: Disc diameter, 1.8*cm*; Arm length, More than 10*cm*.

Ecology: Mud to fine sand bottom, 20-80*m* in depth.

Family Ophiuridae Lyman, 1865

Subfamily Ophiolepidinae Matsumoto, 1915

20. Ophioplocus japonicus H. L. Clark, 1911

Ophioplocus japonicus H. L. Clark, 1911 (p. 30); 1915 (p. 344); Matsumoto, 1917 (p. 302); Murakami, 1942 (p. 31); 1944b (p. 270); A. M. Clark, 1965 (p. 65); Downey, 1969 (p. 178); Kikuchi, 1977 (p. 128); Lee, 1971 (p. 57); Irimura, 1981 (p. 41); 1982 (p. 77).

Specimens examined: Huksando 1983, 1 specimen.

Distribution: Korea (Hongdo, Chejudo, Korea Strait, Chujado, Pusan), other (Japan).

Size: Disc diameter, 1.6*cm*; Arm length, More than 6*cm*.

Ecology: Subtidal hard bottom, low tide level to upper sublittoral zone.

Subfamily Ophiurinae Lyman, 1865

21. Stegophiura sterea (H. L. Clark, 1908)

Ophioglypha sterea H. L. Clark, 1908 (p. 293).

Ophiura sterea: H. L. Clark, 1911 (p. 75).

Stegophiura sterea: Matsumoto, 1917 (p. 258); Murakami, 1942 (p. 27); 1963 (p. 177); D'yakonov, 1949 (p. 58); 1954 (p. 95); Irimura, 1981 (p. 39); 1982 (p. 82).

Stegophiura liodisea Murakami, 1942 (p. 23).

Specimens examined: YL-18-07, 1984, 1 specimen.

Distribution: Korea (Yellow Sea, East Sea, Korea Strait), others (Japan).

Size: Disc diameter, 1.1*cm*; Arm length, 6.7*cm*.

Ecology: Sand to gravely sand bottom, 70-200*m* in depth.

22. Stegophiura sladeni (Duncan, 1879)

Ophioglypha sladeni Duncan, 1879 (p. 485).

Ophiura stiphra: H. L. Clark, 1911 (p. 82).

Stegophiura sladeni: H. L. Clark, 1915 (p. 317); Matsumoto, 1917 (p. 259); D'yakonov, 1954 (p. 88); Murakami, 1963 (p. 177); Lee, 1971 (p. 53); Rho, 1979 (p. 39); Irimura, 1981 (p. 39); 1982 (p. 84).

Specimens examined: YL-01-08, 1982, 1 specimen; YL-02-06, 1983, 2 speceimens; YL-04-05, 1982, 2 specimens; YL-06-05, 1984, 1 specimen; YL-07-07, 1982, 10 specimens; YL-09-06, 1984, 1 specimen; YL-10-06, 1982, 1 specimen; YL-11-04, 1983, 1 specimen; YL-13-04, 1982, 1 specimen; YL-13-01, 1982, 1 specimen; YL-15-05, 1984, 1 specimen; YL-15-14, 1984, 1 specimen; YL-16-07, 1982, 7 specimens; YL-18-04, 1984, 5 specimens; YL-18-07, 1984, 1 specimen; YL-18-10, 1984, 1 specimen; YL-19-13, 1982, 1 specimen; near Huksando, 1984 (by dradge), 64 specimens.

Distribution: Korea (Yellow Sea, Korea Strait, East Sea), others (Japan).

Size: Disc diameter, 1.6*cm*; Arm length, 4.5*cm*.

Ecology: Muddy sand to fine sand bottoms, 50-200*m* in depth.

23. Stegophiura vivipara Matsumoto, 1915 (Fig. 8)

Stegophiura vivipara Matsumoto, 1915 (p. 79); 1917 (p. 255); Murakami, 1942 (p. 28); Downey, 1969 (p. 255); Irimura, 1982 (p. 86).

Specimens examined: YL-08-07, 1983, 1 specimen; YL-06-02, 1984, 2 specimens; YL-12-03, 1984, 7 specimens; YL-18-07, 1984, 1 specimen; YL-18-16, 1984 1 specimen; YL-16-07, 1982, 2 specimens; YL-17-04, 1982, 1 specimen; near Huksando 1984 (by dredge), 2 specimens.

Distribution: Korea (Yellow Sea), others (Japan).

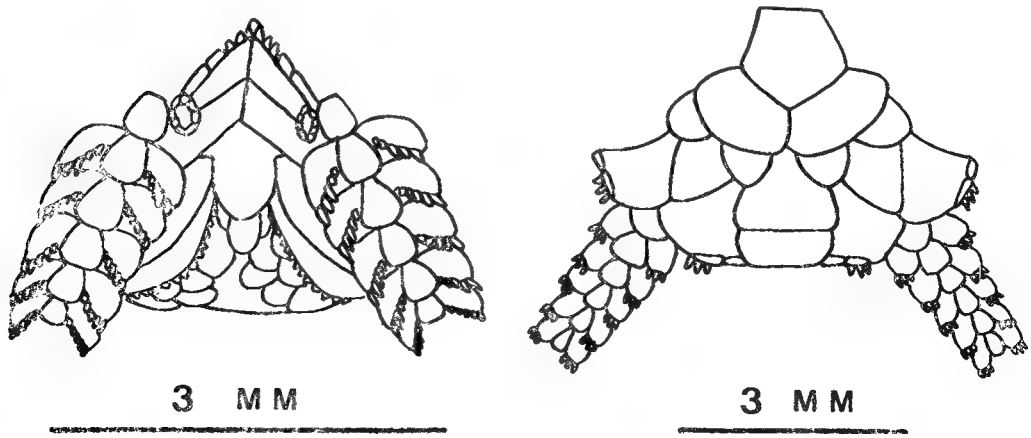

Fig. 8. Ventral and dorsal view of *Stegophiura vivipara*.

Size: Disc diameter, 5*mm*; Arm length, about 10*mm*.

Ecology: Muddy sand to fine sand, shell gravel bottoms, 30-90*m* in depth.

24. Stegophiura sculpta (Duncan, 1879)

Ophioglypha sculpta Duncan, 1879 (p. 455).

Ophiura sculpta: H. L. Clark, 1911 (p. 73).

Stegophiura sculpta: Matsumoto, 1917 (p. 258); Murakami, 1942 (p. 27).

Specimens examined: YL-16-07, 1982, 2 specimens

Distribution: Korea (Yellow Sea, Korea Strait, East Sea), other (Japan),

Size: Disc diameter, 8*mm*; Arm length, 13*mm*.

Ecology: Muddy to fine sand bottoms, 50-90*m* in depth.

25. Ophiura kinbergi (Ljungman, 1866)

Ophioglypha kinbergi: Lyman, 1882 (p. 35); Downey, 1969 (p. 126).

Ophioglypha sinensis Lyman, 1882 (p. 35).

Ophioplyha ferruginea Lyman, 1878 (p. 68); Downey, 1969 (p. 121).

Ophiura kinbergi: H. L. Clark, 1911 (p. 37); 1915 (p. 321); 1938 (p. 358); 1939b (p. 32); Matsumoto, 1917 (p. 271); 1941 (p. 343); Köehler 1930 (p. 222); Murakami, 1942 (p. 28); 1944b (p. 269); Chang, 1948 (p. 63); A. H. Clark, 1949 (p. 55); 1952 (p. 298); D'yakonov, 1954 (p. 102); A. M. Clark, 1965 (p. 66); A. M. Clark and Rowe, 1971 (p. 90); A. M. Clark and Courtman-Stock, 1976 (p. 194); Irimura, 1969 (p. 44); 1979 (p. 4); 1982 (p. 89); Lee, 1971 (p. 54); Rho, 1979 (p. 5).

Specimens examined: 1 to 138 specimens from the most of all of the Yellow Sea stations except some stations less than 40*m* in depth. Numerous specimens by trawl net.

Distribution: Korea (all of the Korean waters), others (Japan, all Indo-West Pacific area).

Size: Disc diameter, Max. 1.3*cm*; Arm length, 6*cm*.

Ecology: Common in muddy to sand bottoms, 10-90*m* in depth.

ABSTRACT

Ophiurans collected in the Yellow Sea by the Korea Ocean Research and Development Institute during the period from 1980 to 1985 were examined. As a result, twenty five species were identified. Among them, *Amphiura iridoides, A. syntharacha, Amphioplus asterictus, Ophionereis sasakii* and *Stegophiura vivipara* were appeared to be new record species in the Korean waters.

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